

## Impact of Ocean Warming and Acidification on Growth of Reef-building Corals

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**Overview:** Coral reef ecosystems are degrading quickly due to a variety of factors at local, regional, and global scales (Wilkinson 1999). Two significant contributing factors are increasing ocean surface temperatures, and decreasing ocean pH (ocean acidification), and both are related to anthropogenic disturbances of the global carbon cycle (Veron et al. 2009). Model projections indicate that ocean temperature will continue to rise and ocean pH will continue to decline over the next 30 to 50 years regardless of any decline in the rate of CO<sub>2</sub> emissions (Wigley 2005). However, there are few empirical data at this time to make educated predictions on the impact of changing temperature and ocean pH on coral reef ecosystems. The results of this study will potentially identify differences in climate vulnerability among three important reef-building coral species, which is very relevant information in making resource management decisions regarding reef restoration and species protection policies. Proposed study sites include Dry Tortugas and Virgin Islands National Parks.

**Project Goal:** A retrospective study addressing long-term variability in ocean temperature and pH using coral cores to investigate the response of coral calcification to the increasing sea surface temperatures, temperature anomaly events, and decreasing ocean pH that have occurred over the last ~150 years. We will also document present-day variability in temperature and coral calcification rates to record important baseline information as ocean conditions continue to change. This study is the first and only field study of this length and spatial magnitude to obtain valuable coral calcification data directly in the units of g CaCO<sub>3</sub> gained per unit time.

**Deliverables:** This is a two-year project that will build on the work being done by the USGS Coral Reef Ecosystem Studies (CREST) Project and the USGS Terrestrial, Freshwater, and Marine Ecosystems Program. Peer-reviewed scientific publications will constitute the majority of the expected products from this project. Within 3 years, 2 – 4 peer-reviewed publications will be submitted, with several more in preparation, documenting and interpreting growth rates in three species of reef building corals and relating the observed changes to variations in ocean temperature and pH. The results will be evaluated in the context of model-projected environmental change for the eastern subtropical North Atlantic and Caribbean Sea in the next 30-50 years. This project will also produce a valuable baseline record of calcification rates throughout the Florida Keys. Technical products resulting from this project will include MatLab® routines for image analysis of coral x-ray for growth and calcification rates that will be provided via the *CREST web site*.

### Timeline:

September 2011: Analysis of coral growth records, Dry Tortugas National Park  
October 2011: Analysis of sea-surface temperature record, Dry Tortugas National Park  
March 2012: Coring of corals, Virgin Islands National Park  
May 2012: Analysis of coral growth records Virgin Islands National Park  
September 2012: Analysis of sea-surface temperature record, Virgin Islands National Park  
January 2013: Final project report